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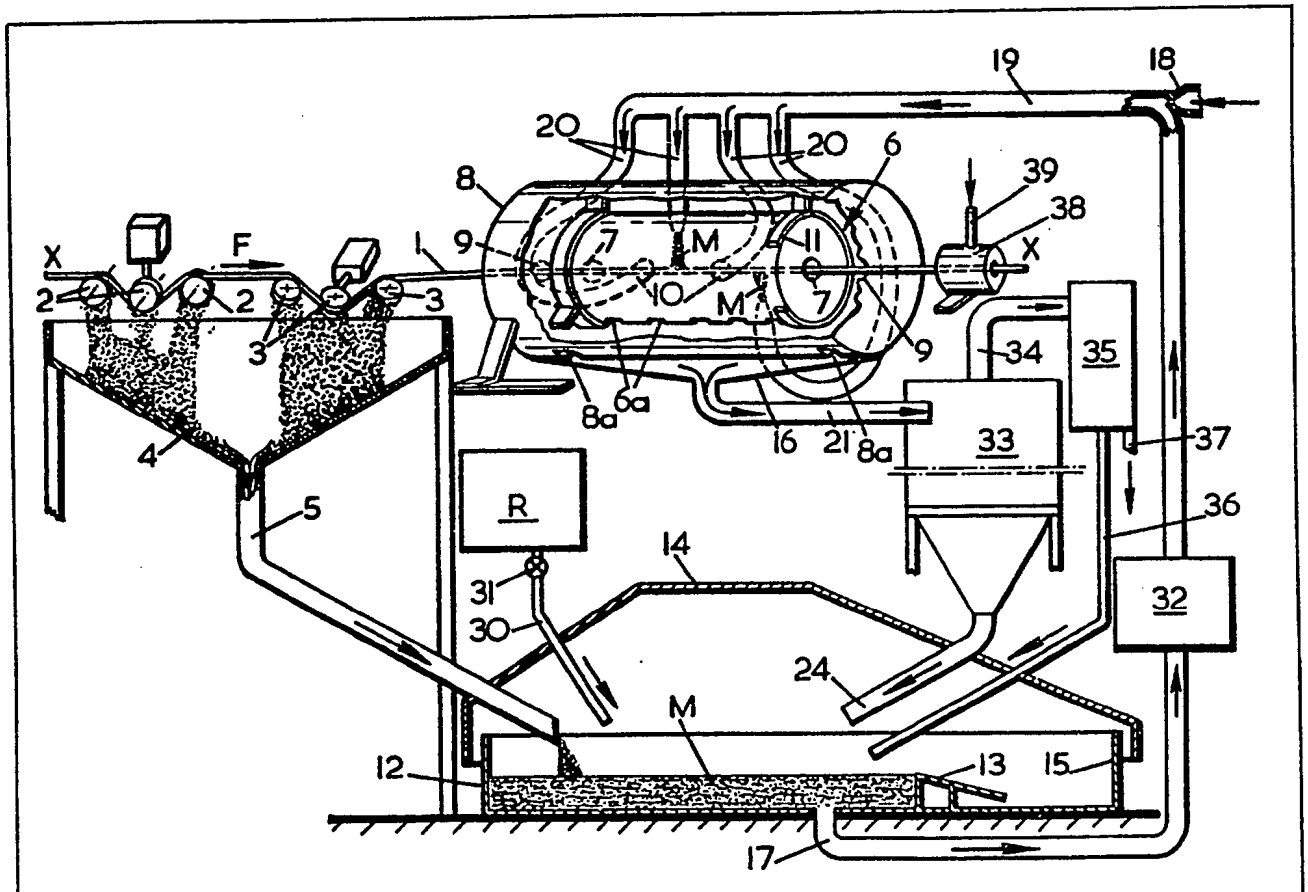
(54) Process and installation for descaling a steel wire

(57) A process for descaling metal wire in which the wire is firstly subjected to bending operations at rollers 2, 3, making it possible to recover the scale, and in which this scale is blasted onto the wire passing inside an enclosure 6, the scale being re-cycled. The scale blasted onto the wire is suspended in a liquid such as water to reduce disintegration. The installation comprises a descaling chamber 6—8 provided with nozzles 10. A circuit 17—32—19—20 makes it possible to convey the mixture M of water and scale from a trough 12 to the nozzles 10. On leaving the descaling chamber, the mixture M is re-cycled and graded by means of a hydrocyclone 33, and a separator 35 to recover the water from smaller non-reusable scale particles. Alternatively, the suspension of such particles is blasted onto the wire at the rollers for the water to be recycled with initial scale.

The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.



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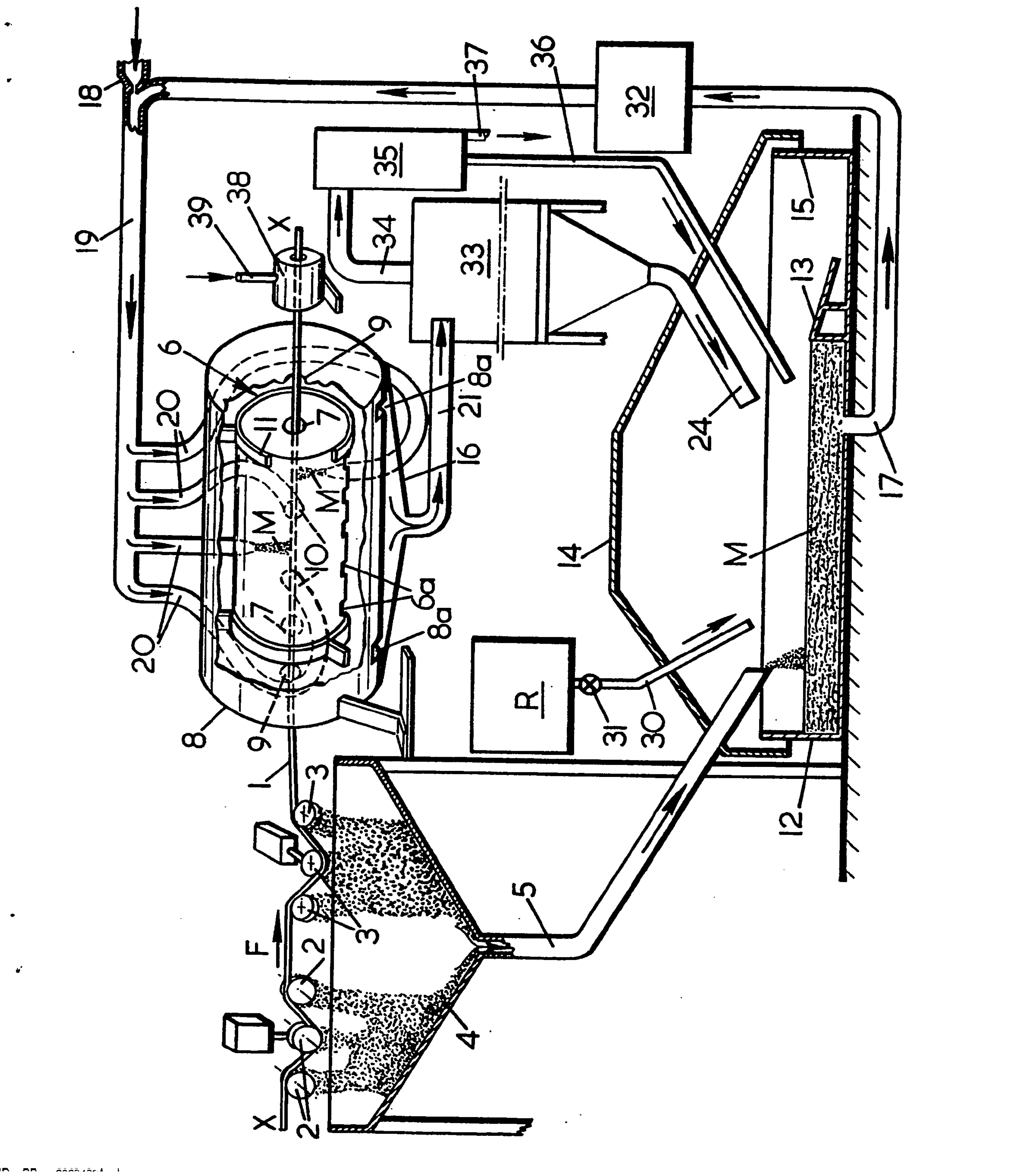
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SPECIFICATION

Process and installation for descaling a steel wire

The present invention relates to the descaling of a wire to obtain a clean wire whose external appearance is shiny and which is suitable for wire-drawing.

Descaling is carried out on a steel wire or so-called "machine wire" after a hot rolling operation and before it is drawn through draw-plates.

A descaling process is known in which the scale recovered from a mechanical device which subjects the wire to multiple and alternate bending is received in a trough then used for descaling the wire by blasting. Moreover, a process of this type provides a circuit for re-cycling the scale incorporating a device for sorting the particles of the latter in order to have a sufficient quantity of scale available for completely descaling the wire treated.

In this process, the scale which is used dry and is simply propelled by a jet of air, breaks up into smaller particles and at the time of re-cycling it is necessary to eliminate from the circuit particles of scale which have become too small and are therefore inefficient when blasted at the wire.

The Applicant has discovered that it is possible to limit the tendency of the scale to break up by using scale in the form of a suspension of scale in a liquid rather than dry particles of scale.

The invention provides a process for descaling a metal wire in which the wire is subjected to bending to recover scale from the wire and the recovered scale is blasted against the wire inside an enclosure through which the wire passes, the scale being re-cycled, characterised in that the scale blasted against the wire is suspended in a liquid.

It has been found that the invention increases the efficiency of the descaling operation.

In the process of the invention, re-cycling of the scale which is in suspension in for example water is maintained by for example a circulating pump.

According to another feature of the invention, sorting of the scale in suspension in water is carried out by means of a hydrocyclone which makes it possible to obtain, on the one hand, a phase containing the large particles of scale which is re-cycled and, on the other hand, greyish water containing the crushed scale dust which can be discharged after having extracted the water therefrom, which extracted water can in turn be re-cycled.

The invention also relates to an installation for carrying out the above process, the installation comprising means for bending a wire to be descaled and for recovering scale removed by the bending of the wire, means for passing the wire through an enclosure, means for blasting the recovered scale against the wire inside the enclosure, and means for re-cycling the scale, characterised in that means are provided for suspending the recovered scale in a liquid, the said blasting means being operative to blast the suspension of scale and liquid against the wire inside the enclosure.

The installation used is scarcely more bulky than that used for a dry descaling operation, but it gives better results in particular as regards the appearance of the descaled wire obtained, which it is nevertheless advisable to dry by means of an annular drying device supplied with air.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing, which is a diagrammatic view, with parts cut away and partial sections, of an installation according to the invention.

According to the embodiment illustrated in the accompanying figure, the installation is intended to treat a metal wire 1 coming from a reel of machine wire which is not shown and moves continuously along its axis X—X in the direction of arrow F.

The invention comprises:

— a bending device,

— a device for cleaning or "sand-blasting" by blasting scale in suspension, in water

— a circuit for re-cycling the scale suspended in water,

— in the re-cycling circuit, a device making it possible to select the suspension of scale according to the size of the particles of scale and to re-cycle the part comprising the larger particles and also to re-cycle the water after having removed the finer particles of scale.

It should be noted that if the term "sand-blasting" is used in this context, there is nevertheless no question of using sand as an abrasive, but solely of using scale in suspension in water. The term "sand-blasting" is the only term available for referring to the operation of blasting an abrasive which, according to the invention, is constituted by a suspension of scale in water.

As known per se, the bending device comprises a first set of three rollers 2, for example in a vertical plane and a second set of three rollers 3 for example in a horizontal plane, the orientation of the plane of the first set of rollers 2 being immaterial, but the plane of the second set being at right-angles to the first.

Located below the two sets of rollers 2 and 3 is a hopper 4 serving as a receptacle for receiving the scale constituted at this level of the installation by dry particles of variable size. The hopper 4 is extended by a downpipe 5.

As known, the device for cleaning or "sand-blasting" by blasting scale in water comprises a sand-blasting chamber 6 with axial inlet and outlet openings 7 for the passage of the metal wir 1 in the direction of arrow F. The chamber 6 is in the general shape of a cylinder on the axis X—X. Its walls preferably consist of flexible material which is resistant to abrasion, such as for example urethane rubber. The chamber 6 comprises openings 6a in its lower part. The descaling chamber 6 is secured by rigid collars 11 for example of cross pieces inside a protective casing 8 which is also cylindrical and arranged on th axis X—X. The protective casing 8 consists of rigid

material. It is also provided with axial inlet and outlet openings 9 for the metal wire 1. Naturally, the axial openings 7 and 9 comprise rings or sleeves for guiding the wire, which have not been shown for the sake of clarity of the drawings. Both the radial and longitudinal dimensions of the casing 8 are substantially greater than those of the descaling chamber 6, in order to provide a wide annular space around the chamber 6. It is possible to use a casing 8 made of steel and comprising a flexible internal coating.

The casing 8 also serves for the recovery and re-cycling of the mixture M serving to descale the wire by being blasted at the latter and which is constituted by a suspension of scale in water. For the recovery of this mixture M, on its cylindrical wall, the casing 8 comprises re-cycling openings 8a along its lower generatrix. Passing through the casing 8 are nozzles 10 for spraying the mixture M onto the wire opening out inside the descaling chamber 6. The nozzles 10 are staggered in an angular manner with respect to each other on the cylindrical periphery of the chamber 6 and also are staggered longitudinally with respect to the wire 1.

The circuit of re-cycling the mixture M of scale and water comprises a trough 12 for storing dry scale coming from the hopper 4. Water is added to this scale (during the phase of starting up the installation), which water comes from a tank R provided with a conduit 30 opening into the trough 12. The conduit 30 is provided with a shut-off valve 31. The trough 12 is connected by an adjustable overflow 13 to an auxiliary trough 15 and is covered by a cover or hood 14 which covers both troughs 12 and 15.

In order to supply the nozzles 10 with the mixture M of scale suspended in water, a pipe 17 leaves the lower part of the trough 12 for the mixture M and rises to the descaling device 6—8. In this part, the pipe 17 passes through a circulating pump 32 for the mixture M. In the vicinity of the descaling device 6—8, a compressed air injector 18 with a venturi nozzle opens into the pipe 17. The injector 18 is connected upstream to a source of compressed air at a pressure which is of the order of 4 to 7 bars and preferably 4 to 5 bars. The pipe 17 is extended in the upper part of the installation by a horizontal pipe 19 arranged coaxially with respect to the venturi nozzle of the injector 18 opening into this pipe 19. The pipe 19 is sub-divided into branch pipes 20 each connected directly to a nozzle 10 for spraying the mixture M of scale and water. By way of example, there are four nozzles 10.

For the return or re-cycling of the mixture M of scale and water, a receptacle 16 is located just below the casing 8 and in particular below its openings 8a. The receptacle 16 is extended by a return pipe 21 which conveys the mixture M of scale and water to a hydrocyclone 33, the mixture having been recovered by the receptacle 16 after having been sprayed through the nozzles 10 onto the wire 1.

The device for selecting particles of scale suspended in the mixture M comprises a hydrocyclone 33 which makes it possible to separate the mixture M which is supplied through the pipe 21 into two phases: a first phase, in which the particles of scale are the largest, is discharged to the trough 12 by means of a pipe 24 and is thus re-cycled. The other phase of the mixture M leaves the hydrocyclone 33 by way of its upper part by means of a pipe 34 and is injected into a separator 35 which makes it possible to extract the water therefrom, which water is re-cycled to the trough 12 by means of a pipe 36 and the finer particles of scale which constitute a sludge which is discharged from the installation by means of a pipe 37. The separator 35 may be a filter, a centrifuge or a simple decantation arrangement.

The installation operates as follows.

By means of this installation, the process of the invention is carried out in the following manner: as known, the metal wire 1 travels at a certain speed V in the direction of arrow F along the axis X—X. The machine wire 1 comprising scale is subjected to bending processes, by passing over the two successive sets of rollers 2 and 3 which break up the layer of scale and cause the wire to lose part of its scale, which is recovered in the receptacle or hopper 4 in order to be conveyed by means of the pipe 5 into the trough 12. During the stage of starting up the installation, the closure member 31 is put in the open position in order to fill the trough 12 with water, contained in the tank R, until the water reaches the level of the overflow 13. A mixture M of scale coming from the hopper 4 and of water is thus formed in the trough 12. This mixture constitutes a suspension of scale in water in which the particles of scale may be of variable size.

The mixture M thus obtained conveyed through the pipe 17 by means of the circulating pump 32 will be supplied to the nozzles 10. A jet of air coming from the nozzle 18 is added to the mixture M at the beginning of the part 19 of the pipe 17. The wire 1, inside the descaling chamber 6, is thus sprayed through the nozzles 10 with jets of scale and water whose kinetic energy is increased by the addition of jets of air through the nozzle 18. Under this action, the wire 1 is completely stripped of any scale which may still adhere thereto despite its passage over the sets of rollers 2 and 3 and thus becomes a clean wire suitable for a wire-drawing operation.

The wire 1 leaves the casing 8 and is dried by means of an annular chamber 38 supplied with air through a pipe 39. The mixture M, which was sprayed through the nozzles 10 onto the wire 1, leaves the descaling chamber 6 through the openings 6a in the latter and reaches the inside of the casing 8 from which it is discharged through the openings 8a. The mixture M is supplied by the return pipe 21 to the hydrocyclone 33. At this point, a certain number of particles of scale are broken up as they are sprayed onto the wire 1 and the mixture M thus comprises water, large

particles of scale and finer particles of scale. This mixtur M is admitt d to the hydrocyclone 33 which separates it into two phases. A first phase, constituted by water and larger particles of scale, which is discharged through the pipe 24 to the trough 12 and thus re-cycled and another part, constituted by water and much finer particles of scale, discharged through the upper pipe 34 to the separator device 35. At the separator 35, the mixture of finer particles of scale and water is divided into water which is re-cycled by means of the pipe 36 which once more opens into the trough 12 and into a sludge constituted by the finer particles of scale which is discharged from the installation through the pipe 37. Thus, by means of the pipes 36 and 24, the trough 12 is re-supplied and the mixture M, from which the finer particles of scale have been removed, is re-cycled. If it should prove necessary, it is possible to add water to the trough 12, by means of the tank R and its pipe 30. The mixture M of scale and water has thus not only been re-cycled, but also in some way purified. In fact, owing to the hydro-cyclone which separates from the mixture M coming from the descaling chamber 6, the phase containing the largest particles of scale and the phase containing the finer particles, the first phase is re-cycled directly, which phase is of the most use, since its particles are the largest. As regards the second phase, by means of the separator 35, it is also divided and the water is re-cycled, the consumption of which is thus minimal, so that topping up the trough 12 by means of the tank R takes place only occasionally. The pipe 37 which leaves the separator 35, makes it possible to eliminate the undesirable part from the mixture M of scale and water, i.e. the part which is constituted by very fine particles of scale, which would have solely a very limited abrasive action when sprayed onto the wire 1 through the nozzles 10.

By means of the nozzle 18 injecting air at a pressure of the order of 5 bars into the mixture of water and scale conveyed through the pipe 19, the jet is accelerated as it leaves, its kinetic energy increases and the efficiency of descaling carried out inside the chamber 6 is increased.

The fact that the wire leaves the casing 8 wet does not constitute a drawback, since the latter can be dried very quickly and very effectively by means of the annular chamber 38 in which the wire is subject to jets of air.

Descaling carried out according to the invention makes it possible to obtain a clean and silky wire, i.e. from which the layer of scale has been completely removed.

The fact that the scale is in suspension in water as soon as it reaches the trough 12, completely eliminates the creation of dust as the installation op rates.

The use of a mixture M of scale suspended in water above all makes it possible to reduce the breaking up of the particles of scale when the latter strike the wire 1 to be descaled. Thus, the discharge through the pipe 37 of the finer particles of scale is reduced as regards quantity.

Not only the scale susp nded in water in order to constitute the mixture M is re-cycled, but also, its tendency to break up is limited and re-cycling is thus more effective.

Several variations of the invention are possible:

— instead of having a chamber 6 separate from the chamber 8 and separated from the latter by an annular space, it is possible to use a cylindrical steel casing 8 lined internally with a coating of flexible material. The nozzles 10 thus open directly into the cavity of the casing 8 which thus becom s the descaling chamber proper. The operation and advantages of this variation are the same as th se previously described.

— Instead of having a single pipe 17 making it possible to convey the mixture M from the vat 12 to the nozzles 10, of which there is only one for all the nozzles 10, it is possible to have a separate pipe of this type for each of the latter. In this case, it would naturally be necessary to provide each pipe with a circulating pump such as 32 and a nozzle for the injection of compressed air such as 18. Thus, the nozzles 10 and their supply circuit are independent and it is possible to work on one of the latter without disturbing the operation of the others.

— In order to form the mixture M, it can be envisaged using a liquid other than water or using water with an additive, in order to obtain a protective film for example on the wire.

— Another variation consists of recovering the water coming from the separator 35 through the pipe 36, not as in the example illustrated directly by emptying the latter into the vat 12 containing the mixture M, but by spraying the latter onto the rollers 2 and 3 of the mechanical descaling device located at the beginning of the installation. The formation of dust is thus completely eliminated, since the scale recovered by the hopper 4 is wet and one also prepares the formation of the mixture M of scale and water which is recovered in the vat 12. This variation makes it possible to descale a wet wire and it is thus useless drying the wire coming from the reel of wire before introducing it into the mechanical descaling device constituted by the sets of rollers 2 and 3.

CLAIMS

1. A process for descaling a metal wire in which the wire is subjected to bending to recover scale from the wire and the recovered scale is blasted against the wire inside an enclosure through which the wire passes, the scale being re-cycled, characterised in that the scale blasted against the wire is suspended in a liquid.

2. A process according to Claim 1, characterised in that the liquid in which the scale is suspended is water.

3. A process according to Claim 1 or 2, charact rised in that the suspension of scale is re-cycled via a circuit comprising a circulating pump and a nozzle for injecting jets of air.

4. A process according to Claim 1, 2 or 3, characterised in that, after blasting and before its

re-cycling, the mixture of scale suspended in liquid is separated into two phases by means of a hydrocyclone, a first said phase containing the largest particles of scale being re-cycled directly, and the other phase containing finer particles of scale and liquid being separated into liquid which is re-cycled and a sludge of said finer particles which is eliminated.

5. A process according to any one of Claims 1 to 4, characterised in that the liquid is re-cycled by pouring it into a vat containing the mixture M of scale and liquid.

6. A process according to any one of Claims 1 to 4, characterised in that the liquid is re-cycled by spraying it onto rollers which bear against the wire, the rollers being incorporated in a mechanical descaling device which is used to effect said bending of the wire to recover the scale.

7. An installation for carrying out the process according to any one of claims 1 to 6, comprising means for bending a wire to be descaled and for recovering scale removed by the bending of the wire, means for passing the wire through an enclosure, means for blasting the recovered scale against the wire inside the enclosure, and means for re-cycling the scale, characterised in that means are provided for suspending the recovered scale in a liquid the said blasting means being operative to blast the suspension of scale and liquid against the wire inside the enclosure.

8. An installation according to Claim 7, wherein said bending means comprises a mechanical descaling device, said blasting means comprises nozzles for spraying scale, and said enclosure comprises a chamber having inlet and outlet openings through which the wire passes, characterised in that there is provided a trough for containing a mixture of scale and liquid, a hopper for receiving scale from the mechanical descaling device, a pipe for conveying scale from the hopper to the trough, and a tank provided with a pipe and a closure member for storing and supplying liquid to the trough.

9. An installation according to Claim 8, characterised in that there is provided at least one conduit comprising a circulating pump and a nozzle for the injection of compressed air for conveying the suspension of scale and liquid from the trough to the spray nozzles.

10. An installation according to Claim 9, characterised in that the descaling chamber and an outer casing thereof are provided with openings located above a receptacle for recovering the mixture of scale and liquid after it has been sprayed onto the wire to be descaled.

11. An installation according to Claim 10, characterised in that the receptacle is arranged to convey the mixture to a hydrocyclone which is adapted to separate it into two phases, one constituted by liquid and the larger particles of scale, a pipe being provided to re-cycle said one phase directly into the trough, and the other constituted by the finer particles of scale, a pipe being provided to convey said other phase to a separator for extracting the liquid therefrom, a further pipe being provided for discharging the finer particles of scale from the installation in the form of a sludge.

12. An installation according to Claim 11, characterised in that a pipe is provided to re-cycle liquid from the separator into the trough containing the mixture of water and scale.

13. An installation according to Claim 11, characterised in that means are provided for spraying re-cycled liquid from the separator onto rollers of the mechanical descaling device.

14. An installation according to any one of Claims 11 to 13, characterised in that the separator is a filter or decantation tank.

15. An installation according to any one of Claims 11 to 13, characterised in that the separator is a centrifuge.

16. An installation according to any one of Claims 7 to 15 characterised in that a drying sleeve supplied with compressed air by means of a pipe is provided for drying the wire after its passage through the enclosure.

17. A process for descaling a metal wire substantially as hereinbefore described with reference to the accompanying drawing.

18. An installation for carrying out the process according to any one of claims 1 to 6, substantially as hereinbefore described with reference to the accompanying drawings.

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